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scratched pebbles and small bowlders, six to eleven feet; fine sand and gravel to the top of a terrace, five feet; height of moraine above terrace, forty feet. The terrace platform spoken of is about eight hundred feet wide. (The accompanying sketch indicates these features, as seen from the creek.) At three stations along the ledge, a large area of the platform was uncovered for the purpose of measuring the angle of direction over as long lines of striation as possible. Repeated observations, corrected for magnetic variation, gave the following result: at the eastern station the direction of the scratches was N. 27° 50' W.; a little over half a mile west, they were N. 23° 50' W.; about an eighth of a mile farther west, N. 22° 30' W. These differences were very unexpected, and hence great care was taken to obtain them accurately. Such angles would indicate a focal point only a few miles to the north-west. In looking over the topography of northern Indiana, it is a remarkable fact, that a ridge of limestone extends across the state, running with the Wabash valley in its eastern section, but striking more westerly in the western part of the state, leaving the Wabash to the south. North of this east and west ridge is a region of marshes and deep sand-deposits, extending to the northern boundary: south of it are more drift-deposits, but not so deep. It seems very probable that a former extension of Lake Michigan found its southern boundary in the neighborhood of this ridge. As the converging lines of our glacial platform seemed to find their centre in the neighborhood of this ridge, it seemed to suggest some relation between them. The first overwhelming flow was parallel with the ridge, and so we find the lower scratches in the Wabash and in Sugar Creek. But afterwards, in the retreat of the great glacier, there seem to have been some local centres along this ridge, which sent out small fan-shaped glaciers with rapidly diverging lines. No other explanation seems to satisfy the angles obtained in this case. Virtually nothing has been done in this state in the way of collecting the facts of the drift; and there is every indication that our relation to the Great Lakes and the peninsula of Michigan, besides the internal features already indicated, present some very interesting and important problems. The legislature of a great educational state cannot yet be induced to appropriate a dollar for any survey which does not deal with the location and thickness of coal-seams and limestone-beds.

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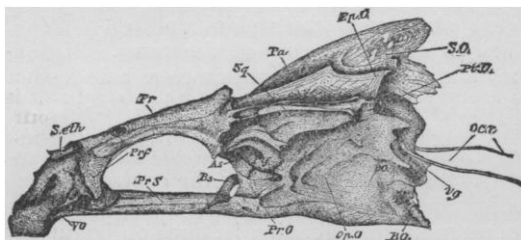
Osteology of *Micropterus salmoides*.

I was very sorry to find from reading Mr. McMurrich's letter in *Science*, No. 69, that its author had derived nothing but the most erroneous ideas from my description of a pair of free ribs at the base of the occiput of *Micropterus* (*Science*, No. 65).

As Mr. McMurrich remarks, it was unfortunate that he was not able to dissect a specimen of the black bass, for the very good reason — which applies more particularly to anatomy — that one should certainly examine, in any case, structures under consideration, before publishing about them, and advancing suggestions as to what they may possibly be. Even where an author specifies that he has not seen the thing whereof he writes, people are often misled. On the other hand, I was glad to see the interest these structures awakened, and will look forward with no little pleasure to Mr. McMurrich's observations upon them, after he has had an opportunity to make a thorough examination.

As an anatomical description is made far clearer

when accompanied by a drawing of the parts discussed, I determined, upon seeing Mr. McMurrich's letter, to follow that rule in the present instance, in my reply to it. To this end, I selected from my private collection a very fine cranium of *Micropterus*, with a pair of well-developed ribs attached to it. From this specimen I made the drawing that illustrates this letter.



Left lateral view of cranium of *Micropterus salmoides*, showing a pair of ribs at the occiput (from nature, half size, linear). *S. eth.*, supra-ethmoid; *Fr.*, frontal; *Sq.*, squamosal; *Pa.*, palatine (not well in sight); *Ep. O.*, epiotic; *SO.*, super-occipital; *Pt. O.*, pterotic; *Oc. r.*, occipital ribs; *v. g.*, foramen for vagus; *E. O.*, ex-occipital; *B. O.*, basi-occipital; *Op. O.*, opisthotic; *Pr. O.*, pro-otic; *Pt. f.*, post-frontal; *A. s.*, all-sphenoid; *B. s.*, basi-sphenoid; *Pr. S.*, para-sphenoid; *Pr. f.*, pre-frontal; *V. o.*, vomere.

From this it is very evident that these ribs are not 'portions or rudiments of the supraclaviculae,' but really have all the characteristics of the ribs upon the atlas and axis. I have never found epipleural appendages attached to them, as I believe may occur on the first two ribs of the column. Dr. Sagemehl, in his valuable paper on the cranium of *Amia* (*Morphologisches Jahrbuch*, ix.), is very explicit in what he says about the co-ossification of the three vertebrae with the basi-occipital of this ganoid; and if this author had been aware of such a state of affairs as I here figure, in any of the Teleostei, he certainly would have brought it forward in connection with the discussion of that subject. They are two very significant facts, that these ribs in *Micropterus* articulate *beyond* the vagus foramen, and that they are apparently constant. I have since found similar structures in a specimen of *Oreochromis thynnus*, and rather suspect it in the *Scombridae*, though the specimens at my command, illustrating this latter group, were so poorly prepared, I could not satisfy myself in regard to them. It will be of great interest and importance to examine, in this particular, forms more or less nearly related to *Micropterus*, and the young of all, at various stages. Of their nature, I think it may be said without doubt, that they are a pair of true ribs, agreeing in all important particulars with the abdominal ribs, as seen in the pairs on the atlas and axis; that they belong to the same series, and articulate with the occiput, to which they belong; and that they are a constant character.

I should be rather surprised to find that these structures had not been noticed before, occurring as they do in a form that has received so much attention, from an anatomical point of view, as *Oreochromis*. Then, too, taking into consideration the morphological significance that attaches to them, one would look for at least a mention of such a condition in the textbooks of Owen, Huxley, Gegenbaur, Parker, or others; but such I have failed to find, and the embryologists seem also to have overlooked them. Sir Richard Owen would certainly have had occasion to mention such a pair of ribs in his method of treating the osteology of the piscine skull.

R. W. SHUFELDT.

Washington, June 2.